



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11) EP 1 361 597 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
12.11.2003 Bulletin 2003/46

(51) Int Cl.7: H01J 29/50

(21) Application number: 03009981.6

(22) Date of filing: 02.05.2003

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HU IE IT LI LU MC NL PT RO SE SI SK TR
Designated Extension States:
AL LT LV MK

(72) Inventors:
• Sueno, Masahiko
Takatsuki-shi, Osaka 569-0851 (JP)
• Ohta, Kazunori
Takatsuki-shi, Osaka 569-0822 (JP)
• Ueda, Yasuyuki
Hirakata-shi, Osaka 573-1152 (JP)

(30) Priority: 10.05.2002 JP 2002135104

(71) Applicant: MATSUSHITA ELECTRIC INDUSTRIAL
CO., LTD.
Kadoma-shi, Osaka 571-8501 (JP)

(74) Representative: Stippl, Hubert, Dipl.-Ing.
Hafner & Stippl,
Patentanwälte,
Schleiermacherstrasse 25
90491 Nürnberg (DE)

(54) Color picture tube device

(57) The present invention provides a high-resolution color picture tube device with a decreased beam spot diameter. The color picture tube device has an electron gun (23) including cathodes (1), a control electrode (2), an accelerating electrode (3), a G3 electrode (4), a first focusing electrode (5), a second focusing electrode (6), and a final accelerating electrode (7) that are arranged in this order. A voltage applied to the G3 elec-

trode (4) is obtained by dividing with a resistor (10) a voltage applied to the final accelerating electrode (7), and when an electron beam is in a non-deflection state, a relationship represented as $V_a > V_{g3} > V_{foc2}$ is satisfied where V_a , V_{g3} , and V_{foc2} denote voltages respectively applied to the final accelerating electrode (7), the G3 electrode (4) and the second focusing electrode (6). Thereby, the G3 electrode (4) is applied with a high voltage independently for forming a prefocus lens.

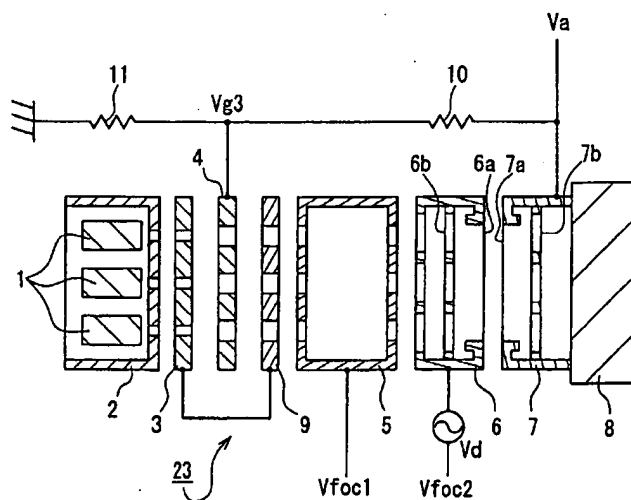


FIG. 2

Description

[0001] The present invention relates to a color picture tube device configured to obtain a high resolution across a whole screen of a picture tube. More specifically, the present invention relates to an electron gun used in the color picture tube device.

[0002] A color picture tube is required to have a high resolution. FIG. 8 shows an example of a conventional electron gun providing a high-resolution color picture tube with a reliable and simple configuration, which is disclosed in JP 07(1995) 6706. As shown in FIG. 8, an electron gun 100 has cathodes 101, a control electrode 102, an accelerating electrode 103, a G3 electrode 104, a first focusing electrode 105, a second focusing electrode 106, a final accelerating electrode 107 and a shield cup 108, which are arranged in this order. The accelerating electrode 103 and the G3 electrode 104 form a prefocus lens, while the second focusing electrode 106 and the final accelerating 107 form a main lens.

[0003] A constant voltage V_{g3} (9.0 kV) is applied to the G3 electrode 104, while a constant voltage V_{foc2} (6.5 kV) and a dynamic voltage V_d superimposed thereon are applied to the second focusing electrode 106, thereby keeping a relationship of $V_{g3} > V_{foc2}$.

[0004] The dynamic voltage, which is 0V when the deflection angle of an electron beam is 0, will rise gradually with the increase of the deflection angle. This strengthens a quadrupole lens electric field formed by the first focusing electrode 105 and the second focusing electrode 106.

[0005] In this configuration, the voltage V_{g3} at the prefocus lens side can be applied separately from the voltage V_{foc2} configuring a main lens at the low voltage side. Thereby, the voltage V_{foc2} can be set lower than V_{g3} while maintaining the level of the voltage V_{g3} . In this manner, the characteristics of the prefocus lens are maintained and a reliable color picture tube device having a high resolution can be provided.

[0006] In such a conventional electron gun, a sufficient potential difference is maintained between the voltage V_{g3} (9.0 kV) and a voltage of the accelerating electrode 103, as the voltage of the accelerating electrode 103 is equal to the voltage V_{foc1} (600 V) applied to the first focusing electrode 105. However, a potential difference between the first focusing electrode 105 (600 V) and the second focusing electrode 106 (6.5 kV) is increased, causing the formation of a considerably strong quadrupole lens when an electron beam is not deflected. As a result, the quadrupole lens will have an increased astigmatism, limiting a reduction of the spot diameter of the electron beam on the screen.

[0007] Moreover in this configuration, V_{foc1} is lower than V_{foc2} under a non-deflection condition, and the dynamic voltage V_d is raised gradually with the increase in the deflection angle so as to change the quadrupole lens, and thus the sensitivity in correcting the deflection astigmatism with respect to the dynamic voltage is inferior.

rior.

[0008] In order to solve the above-described problems in conventional techniques, an object of the present invention is to provide a color picture tube device with a small beam spot diameter to provide a high resolution.

[0009] For achieving the above-described object, a first color picture tube device according to the present invention has an electron gun including cathodes, a control electrode, an accelerating electrode, a G3 electrode, a first focusing electrode, a second focusing electrode and a final accelerating electrode that are arranged in this order. A voltage applied to the G3 electrode is obtained by dividing with a resistor a voltage applied to the final accelerating electrode, and a relationship represented as $V_a > V_{g3} > V_{foc2}$ is satisfied when an electron beam is not deflected, where V_a denotes the voltage applied to the final accelerating electrode, V_{g3} denotes the voltage applied to the G3 electrode, and V_{foc2} denotes a voltage applied to the second focusing electrode.

[0010] A second color picture tube device according to the present invention has an electron gun including cathodes, a control electrode, an accelerating electrode, a G3 electrode, a first focusing electrode, a second focusing electrode and a final accelerating electrode that are arranged in this order. A voltage applied to the G3 electrode is obtained by dividing with a resistor a voltage applied to the final accelerating electrode, a relationship represented as $V_{g3} > 9$ kV is satisfied, and a relationship represented as $V_a > V_{g3} > V_{foc1} > V_{foc2}$ is satisfied when an electron beam is not deflected, where V_a denotes the voltage applied to the final accelerating electrode, V_{g3} is a voltage applied to the G3 electrode, V_{foc1} denotes a voltage applied to the first focusing electrode and V_{foc2} denotes a voltage applied to the second focusing electrode.

[0011] FIG. 1 is a cross-sectional view showing a color picture tube device according to one embodiment of the present invention.

[0012] FIG. 2 is a cross-sectional view showing an electron gun according to a first embodiment of the present invention.

[0013] FIG. 3 shows a gun base that is viewed in the direction pointed as 'A' in FIG. 1.

[0014] FIG. 4 is a graph showing a relationship between a voltage V_{g3} and a spot diameter of an electron beam in a case of using the electron gun according to the first embodiment of the present invention.

[0015] FIG. 5 is a cross-sectional view showing an electron gun according to a second embodiment of the present invention.

[0016] FIG. 6 is a cross-sectional view showing an electron gun according to a variation of the second embodiment of the present invention.

[0017] FIG. 7 is a graph showing a relationship between a voltage V_{g3} and a spot diameter of an electron beam in a case of using the electron gun according to the second embodiment of the present invention.

[0018] FIG. 8 is a cross-sectional view of a conventional electron gun.

[0019] In the first color picture tube device of the present invention, since a voltage applied to the G3 electrode is obtained by dividing with a resistor a voltage applied to the final accelerating electrode, the G3 electrode can be applied with a voltage separately from the first focusing electrode and the second focusing electrode. Thereby, the first focusing electrode and the second focusing electrode are applied with high voltages, and further the G3 electrode can be applied with a high voltage independently for forming a prefocus lens.

[0020] According to a second color picture tube device of the present invention, the voltage V_{g3} applied to the G3 electrode can be increased to strengthen the prefocus lens. In addition, by setting the lower voltages V_{foc1} and V_{foc2} in a relationship of $V_{foc1} > V_{foc2}$ not deflected, the quadrupole lens for correcting the deflection astigmatism formed from the screen center can be weakened with the rise in the dynamic voltage, and this can improve the sensitivity in correcting the deflection astigmatism with respect to the dynamic voltage and also reduce the amount of the dynamic voltage. Therefore, an electron gun with a smaller beam spot diameter and an excellent focusing property can be provided.

[0021] In each of the first and second color picture tube devices, it is preferable that the accelerating electrode and the G3 electrode are applied with voltages separately from the voltages applied to the first and second focusing electrodes, and that a lens electric field between the accelerating electrode and the G3 electrode, and a lens electric field between the first focusing electrode and the second focusing electrode, are formed respectively with independently-applied voltages. In this configuration, it is possible to maintain the focusing action of a prefocus lens formed between the G3 electrode and the accelerating electrode, while preventing a quadrupole lens formed between the first focusing electrode and the second focusing electrode from being strengthened excessively when an electron beam is not deflected.

[0022] In any of the first and second color picture tube devices, it is preferable that the G3 electrode is applied with a voltage that is obtained by dividing with a resistor a voltage supplied from an anode in the color picture tube device to the final accelerating electrode, and that the first and second focusing electrodes are applied with voltages that are supplied through pins of a stem provided in the color picture tube device. According to the configuration, a limited number of pins of a stem for a high voltage can be used effectively. Moreover, it is possible to apply the G3 electrode with a voltage higher than the upper limit of the voltage supplied through the pins of the stem.

[0023] It is preferable in the first color picture tube device that the voltage V_{g3} is higher than 9 kV, thereby strengthening focusing action of a prefocus lens formed between the accelerating electrode and the G3 elec-

trode.

[0024] It is preferable in any of the first and second color picture tube devices that an intermediate electrode is arranged between the second focusing electrode and the final accelerating electrode, and that a voltage (V_m) applied to the intermediate electrode is higher than V_{foc1} . Accordingly, a main lens electric field can be extended in the axial direction of the electron gun and the effective lens diameter of the main lens can be enlarged, thereby further decreasing the spot diameter of the electron beam.

[0025] Color picture tube devices according to one embodiment of the present invention are explained below by referring to the attached drawings.

(First Embodiment)

[0026] FIG. 1 is a cross-sectional view showing a color picture tube device according to one embodiment of the present invention. In FIG. 1, an electron gun 23 is provided within a neck portion 22a of a glass bulb 22 of a color picture tube device 21. An electron beam 24 emitted from the electron gun 23 is deflected by a deflection yoke 25, and reaches a phosphor screen 27 through a shadow mask 26 as a color selection electrode. A stem 28 with pins 29 is provided at an end of the neck portion 22a, and a voltage used in the electron gun 23 is supplied through the pins 29.

Here, the stem 28 is provided with a gun base 28a to expose the pins 29.

[0027] FIG. 2 is a cross-sectional view showing a main part of the electron gun 23 in FIG. 1. The electron gun 23 is configured with cathodes 1 that are in-line placed corresponding to three colors of RGB, a control electrode 2 (G1 electrode), an accelerating electrode 3 (G2 electrode), a G3 electrode 4, a first focusing electrode 5, a second focusing electrode 6, a final accelerating electrode 7 and a shield cup 8, which are arranged in this order in the axial direction of the color picture tube.

[0028] An auxiliary electrode 9 is arranged between the G3 electrode 4 and the first focusing electrode 5. This auxiliary electrode 9 is connected electrically to the accelerating electrode 3, so that these two electrodes will have an identical potential when applied with a voltage.

[0029] The G3 electrode 4 and the final accelerating electrode 7 are connected electrically to each other through a resistor 10 provided in the vicinity of the internal electron gun 23, and further the G3 electrode 4 is grounded through a resistor 11 provided in the vicinity of the electron gun 23. Thereby, a voltage V_a applied to the final accelerating electrode 7 is divided in the potential, and the thus divided voltage V_{g3} is applied to the G3 electrode 4.

[0030] The first focusing electrode 5 is applied with a voltage V_{foc1} , and the second focusing electrode 6 is applied with a voltage V_{foc2} and a dynamic voltage V_d .

superimposed thereon. The dynamic voltage V_d , which is 0 V when the deflection angle of an electron beam is 0, will rise gradually with an increase of the deflection angle.

[0031] The accelerating electrode 3, the G3 electrode 4 and the auxiliary electrode 9 are formed as flat plates, each of which is provided with three apertures formed corresponding to three electron beams. Similarly, three apertures are formed in the control electrode 2. The first focusing electrode 5 is a tubular electrode sealed with flat plates at the auxiliary electrode 9 side and at the second focusing electrode 6 side, and each of the flat plates is provided with three apertures for passing electron beams. The accelerating electrode 3, the G3 electrode 4 and the auxiliary electrode 9 will not be limited to flat plates, but these electrodes can be formed to be tubular. Similarly, the first focusing electrode 5 and the second focusing electrode 6 will not be limited to tubes, but these electrodes can be formed as thick plates.

[0032] Both the second focusing electrode 6 and the final accelerating electrode 7 are tubular electrodes, and each has an opening 6a or 7a at the end for passing three electron beams RGB. Plate-shaped field-forming electrodes 6b, 7b are arranged inside the tubes with respect to the openings 6a or 7a. These field-forming electrodes 6b, 7b are used for separating the lens electric field into lenses corresponding to the three electron beams, and each of the field-forming electrodes 6b, 7b is provided with three apertures corresponding to be respective three electron beams.

[0033] By configuring the second focusing electrode 6 and the final accelerating electrode 7 as described above, the three adjacent lens electric fields overlap each other in the horizontal direction (the in-line alignment direction of the cathodes 1), thereby substantially increasing the lens diameter.

[0034] The lens diameter can be adjusted corresponding to the shape and diameter of the openings in the tubular electrodes 6, 7, the shape and diameter of each aperture of the field-forming electrodes 6b, 7b, and the position of the field-forming electrode 6b, 7b in a relation with the openings 6a, 7a of the tubular electrodes 6, 7. The flat plate field-forming electrodes 6b, 7b can be replaced by screen-like electrodes.

[0035] When respective electrodes of the thus configured electron gun are applied with certain voltages, a prefocus lens is formed between the accelerating electrode 3 and the G3 electrode 4. In addition, a uni-potential type focusing lens is formed with the G3 electrode 4, the auxiliary electrode 9 and the first focusing electrode 5. Between the first focusing lens 5 and the second focusing lens 6, a quadrupole electrode that corrects deflection astigmatism varying its strength with electron beams being deflected around the screen is formed, while a main lens is formed between the second focusing lens 6 and the final accelerating lens 7.

[0036] In a case of a color TV picture tube with a 76 cm type or 86 cm type (aspect ratio of 16:9) large

screen, the voltage to be applied to the control electrode 2 is substantially 0 V, about 300 V to 800 V to the accelerating electrode 3 and the auxiliary electrode 9, and about 4 kV to 9 kV as a voltage V_{foc1} to the first focusing electrode 5.

[0037] The second focusing electrode 6 is applied with a voltage formed by superimposing on a voltage V_{foc2} of about 4 kV to 9 kV a dynamic voltage V_d that varies depending on deflection.

[0038] FIG. 3 shows the gun base 28a in FIG. 1 viewed in the direction identified with an arrow 'A'. The stem 28 provided with the gun base 28a has plural pins 29 arranged substantially around its circumference. Voltages applied to the above-described control electrode 2, the accelerating electrode 3, the auxiliary electrode 9, the first focusing electrode 5 and the second focusing electrode 6 will be supplied through the pins 29. The voltage V_{foc1} and V_{foc2} applied respectively to the first focusing electrode 5 and the second focusing electrode 6 are supplied through the pins 29a and 29b spaced from the other pins, since the voltages are higher than the voltages applied to the remaining electrodes.

[0039] The final accelerating electrode 7 is applied with a voltage V_a of about 20 kV to 35 kV. The voltage V_a is supplied from an anode contact 30 (FIG. 1) on the glass bulb 22 of the picture tube device through a conductive film on the inner surface of the envelope 22. In this case, the voltage V_{g3} , which is obtained by dividing the voltage V_a with the resistor 10, will not be supplied necessarily through the pins 29 of the stem 28.

[0040] In this configuration, a relationship represented as $V_a > V_{g3} > V_{foc1} > V_{foc2}$ is maintained when an electron beam is not deflected, where V_a denotes a voltage supplied from the anode contact 30, V_{g3} denotes a voltage obtained by dividing the voltage V_a , and V_{foc1} and V_{foc2} are supplied through the pins 29 of the stem 28. For example, when V_a is 29.5 kV, V_{g3} is 11 kV, V_{foc1} is 7 kV, and V_{foc2} is 6 kV.

[0041] V_{g3} , which is higher than V_{foc1} and V_{foc2} , can strengthen the prefocus lens. Furthermore, due to the relationship of $V_{foc1} > V_{foc2}$, a potential difference between the first focusing electrode 5 and the second focusing electrode 6 is decreased with the rise of the dynamic voltage V_d . Thereby, the quadrupole lens for correcting the deflection astigmatism formed from the screen center can be weakened with the rise of the dynamic voltage. Namely, the sensitivity in correcting the deflection astigmatism with respect to the dynamic voltage V_d can be improved, and the amount of the dynamic voltage V_d can be reduced.

[0042] The voltage V_{g3} is obtained by dividing the voltage V_a from the anode contact 30. Therefore, it can be a high voltage, just the voltages V_{foc1} and V_{foc2} , both of which are supplied through the pins 29 of the stem 28, are high. In this case, even an increased voltage V_{g3} will affect the main lens less, and the prefocus lens and the main lens can be optimized independently to decrease the spot diameter of the electron beam.

[0043] As described above, raising the voltage supplied to the pins 29 of the stem 28 may cause an electrical discharge among the adjacent pins, and the number of pins to be applied with the high voltage is limited to two, i.e., the pins 29a and 29b in FIG. 2. In the conventional configuration as shown in FIG. 8, two pins for high voltage are used in the G3 electrode 104 for forming a prefocus lens and also in the second focusing electrode 106 for forming a main lens.

[0044] In this case, Vfoc1 applied to the first focusing electrode 105 though the pins cannot be raised considerably. As a result, a potential difference between the first focusing electrode 105 (600 V) and the second focusing electrode 106 (6.5 kV) is increased, resulting in formation of an extremely strong quadrupole lens when the electron beam is not deflected.

[0045] In this embodiment, the voltage Vg3 can be raised as well as the voltages Vfoc1 and Vfoc2, while the accelerating electrode 3 opposing the G3 electrode 4 applied with the high voltage Vg3 can be applied with a low voltage through the pins 29 of the stem 28, and the low voltage is applied separately from the voltage Vfoc1. That is, a lens electric field between the accelerating electrode 3 and the G3 electrode 4, and a lens electric field between the first focusing electrode 5 and the second focusing electrode 6, are formed respectively with independently-applied voltages. Therefore, the focusing action of the prefocus lens formed between the G3 electrode 4 and the accelerating electrode 3 is secured, while the quadrupole lens formed between the first focusing lens 5 and the second focusing lens 6 is prevented from being strengthened excessively when the electron beam is not deflected.

[0046] In the conventional configuration as shown in FIG. 8, the voltage Vg3 can be raised. However, there is an upper limit in the applied voltage, since the voltage Vg3 is supplied through the pins of the stem. More specifically, the upper limit of the voltage applied to the pins is about 9 kV, since an electrical discharge may occur among the adjacent pins as the voltage supplied to the pins is raised. In the embodiment of the present invention, since the voltage Vg3 is obtained by dividing the voltage Va from the anode contact, the applied voltage can be over 9 kV.

[0047] An experimental result about a relationship between the voltage Vg3 and the beam spot diameter for an electron gun according to this embodiment is shown in FIG. 4. In this experiment, Va, Vfoc1 and Vfoc2 were fixed respectively to 29.5 kV, 7 kV, and 6 kV, while only Vg3 was varied.

[0048] In the experiment, diameters of apertures formed in the control electrode 2, the accelerating electrode 3 and the G3 electrode 4 were determined respectively to 0.5 mm, 0.5 mm, and 0.9 mm, and the effective lens diameter of the main lens was determined to be about 11 mm.

[0049] Experimental results for an electron gun in a comparative example are also shown in the same figure.

The electron gun in the comparative example was the same as the example of the present invention, except that Vfoc1 = 600 V and Vfoc2 = 6.5 kV.

[0050] As shown in FIG. 4, the spot diameter (y-axis) is decreased as the voltage Vg3 (x-axis) is raised for both the example (line 34) and the comparative example (line 33). However, the spot diameter for the line 34 is smaller by about 10% in comparison with that of the line 33 when Vg3 of the electron gun of the example was equal to that of the comparative example.

[0051] As mentioned above, the upper limit of the voltage applied through the pins of the stem is 9 kV in the conventional electron gun. On the other hand, no discharges occurred among the pins of the stem even when Vg3 exceeded 9 kV in this example where Vg3 was not applied through the pins of the stem but supplied by dividing a voltage Va from the anode contact through a division resistor. The values for Vg3 over 11 kV are omitted from the figure, since there was no substantial change in the spot diameter after Vg3 exceeded this value.

(Second Embodiment)

[0052] Next, an electron gun according to a second embodiment of the present invention will be described by referring to FIG. 5. As shown in FIG. 5, an electron gun 31 in the second embodiment is substantially identical to the electron gun 23 shown in FIG. 1, except that an intermediate electrode 20 is arranged between the second focusing electrode 6 and the final accelerating electrode 7. This intermediate electrode 20 is connected electrically to the final accelerating electrode 7 through a resistor 21. Thereby, the intermediate electrode 20 is applied with a voltage Vm that is obtained by dividing the voltage Va.

[0053] Similar to the second focusing electrode 6 and the final accelerating electrode 7, the intermediate electrode 20 is formed as a tubular electrode having openings 20a, 20c formed opposing the electrodes at the both sides, and a field-forming electrode 20b as a flat plate having three apertures is provided in the vicinity of the center of the interior. Explanations for components numbered identically to those of FIG. 1 are omitted in the figure, as the components have the same configurations. A plurality of intermediate electrodes can be provided in the axial direction. A configuration providing a screen-like electrodes to the field-forming electrode within the intermediate electrode can be selected as well. Alternatively, an intermediate electrode having no field-forming electrodes can be used.

[0054] By inserting the intermediate electrode 20, the main lens electric field can be extended in the axial direction of the electron gun, thereby enlarging the effective lens diameter of the main lens. As a result, the spot diameter of the electron beam can be decreased further.

[0055] Voltages applied to the respective electrodes of the electron gun 31 in this embodiment are, for ex-

ample, $V_a = 29.5$ kV, $V_m = 12$ kV, $V_{foc1} = 7$ kV, and $V_{foc2} = 6$ kV. V_m is set to be higher than V_{foc1} in order to enlarge the main lens electric field in the axial direction. V_{g3} applied by the resistors 10, 11 and 21 is 12 kV and higher than V_{foc1} and V_{foc2} . Alternatively, as shown in FIG. 6, the intermediate electrode 20 and the G3 electrode 4 are connected electrically so as to be applied with an identical voltage of 12 kV. In this configuration, the number of extraction contacts from the resistors within the tube can be decreased. Alternatively, V_{foc1} can be divided by means of a resistor and supplied as shown in FIG. 6.

[0056] FIG. 7 shows an experimental result for a relationship between the voltage V_{g3} and a beam spot diameter for the electron gun of this embodiment. In this experiment, the values of V_a , V_m , V_{foc1} and V_{foc2} were fixed respectively to 29.5 kV, 12 kV, 7 kV, and 6 kV, while only V_{g3} was varied. The shapes of the apertures formed in the control electrode 2, the accelerating electrode 3 and the G3 electrode 4 were the same as those in the first embodiment.

[0057] As expressed in a line 35 in FIG. 7, the spot diameter (y-axis) is decreased as the voltage V_{g3} (x-axis) is raised. In addition, in comparison with the experimental result of FIG. 4 referring to the first embodiment (line 34), the spot diameter at the same voltage V_{g3} is smaller in this embodiment than in the first embodiment. The values for V_{g3} over 11 kV are omitted from the figure, since there were no substantial change in the spot diameter after V_{g3} exceeded this value.

[0058] In each of the electron guns described in the first and second embodiments, one set of dynamic quadrupole lens is used. Alternatively, the quadrupole lens can be used with another set of quadrupole lens having a reverse action in the horizontal and vertical directions and positioned at the cathode side. In this case, the set of quadrupole lens at the main lens side functions mainly to correct the astigmatism caused by deflection astigmatism while the quadrupole lens at the cathode side functions to mainly correct the difference in the horizontal and vertical lens magnification dynamically corresponding to the respective deflections. Alternatively, the electron gun according to the respective embodiments can be combined with a multistage focusing lens.

[0059] In each of the electron guns of the respective embodiments, an auxiliary electrode 9 is arranged between the G3 electrode 4 and the first focusing electrode 5, and the auxiliary electrode 9 is applied with the same voltage as to the accelerating electrode 3. Alternatively, the auxiliary electrode 9 can be applied with a voltage of either V_{foc1} or V_{foc2} . Alternatively, plural or no auxiliary electrodes 9 can be provided.

[0060] As described above, a voltage applied to the G3 electrode is obtained by dividing with a resistor a voltage applied to the final accelerating electrode, so that the G3 electrode can be applied with a voltage separately from the first and second focusing electrodes. Therefore, the first and second focusing electrodes are

applied with high voltages, and moreover, the G3 electrode can be applied with a high voltage independently for forming a prefocus lens.

Claims

1. A color picture tube device comprising an electron gun comprising cathodes, a control electrode, an accelerating electrode, a G3 electrode, a first focusing electrode, a second focusing electrode and a final accelerating electrode that are arranged in this order, wherein

a voltage applied to the G3 electrode is obtained by dividing with a resistor a voltage applied to the final accelerating electrode; and when an electron beam is not deflected, the color picture tube device satisfies a relationship represented as:

$$V_a > V_{g3} > V_{foc2}$$

where V_a denotes the voltage applied to the final accelerating electrode, V_{g3} denotes the voltage applied to the G3 electrode, and V_{foc2} denotes a voltage applied to the second focusing electrode.

2. The color picture tube device according to claim 1, wherein the accelerating electrode and the G3 electrode are applied with a voltage separately from the first focusing electrode and the second focusing electrode, and a lens electric field between the accelerating electrode and the G3 electrode, and a lens electric field between the first focusing electrode and the second focusing electrode are formed respectively with independently-applied voltages.
3. The color picture tube device according to claim 1, wherein the voltage applied to the G3 electrode is obtained by dividing with a resistor a voltage supplied from an anode in the color picture tube device to the final accelerating electrode, and the voltages applied to the first focusing electrode and the second focusing electrode are supplied through pins of a stem provided in the color picture tube device.
4. The color picture tube device according to claim 1, further satisfying a relationship represented as:

$$V_a > V_{g3} > V_{foc1} > V_{foc2}$$

when the electron beam is not deflected, where V_{foc1} denotes the voltage applied to the first focusing electrode.

5. The color picture tube device according to claim 1, wherein V_{g3} is higher than 9 kV.

6. The color picture tube device according to claim 1, wherein an intermediate electrode is arranged between the second focusing electrode and the final accelerating electrode, and a voltage V_m applied to the intermediate electrode is higher than V_{foc1} . 5
7. A color picture tube device comprising an electron gun comprising cathodes, a control electrode, an accelerating electrode, a G3 electrode, a first focusing electrode, a second focusing electrode and a final accelerating electrode that are arranged in this order, wherein 10
- a voltage applied to the G3 electrode is obtained by dividing with a resistor a voltage applied to the final accelerating electrode, 15
- the color picture tube device satisfies a relationship represented as:

$$V_{g3} > 9 \text{ kV} \quad 20$$

and the color picture tube device satisfies also a relationship represented as:

$$V_a > V_{g3} > V_{foc1} > V_{foc2} \quad 25$$

when an electron beam is not deflected, where V_a denotes the voltage applied to the final accelerating electrode, V_{g3} denotes the voltage applied to the G3 electrode, V_{foc1} denotes a voltage applied to the first focusing electrode, and V_{foc2} denotes a voltage applied to the second focusing electrode. 30

8. The color picture tube device according to claim 7, wherein accelerating electrode and the G3 electrode are applied with a voltage separately from the first focusing electrode and the second focusing electrode, and a lens electric field between the accelerating electrode and the G3 electrode, and a lens electric field between the first focusing electrode and the second focusing electrode are formed respectively with independently-applied voltages. 35 40
9. The color picture tube device according to claim 7, wherein the voltage applied to the G3 electrode is obtained by dividing with a resistor a voltage supplied from an anode in the color picture tube device to the final accelerating electrode, and the voltages applied to the first focusing electrode and the second focusing electrode are supplied through a stem pin provided in the color picture tube device. 45 50
10. The color picture tube device according to claim 7, wherein an intermediate electrode is arranged between the second focusing electrode and the final accelerating electrode, and a voltage applied to the intermediate electrode is higher than V_{foc1} . 55

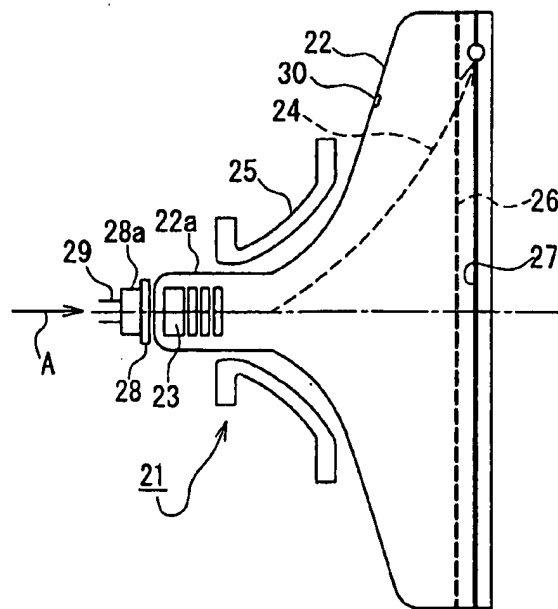


FIG. 1

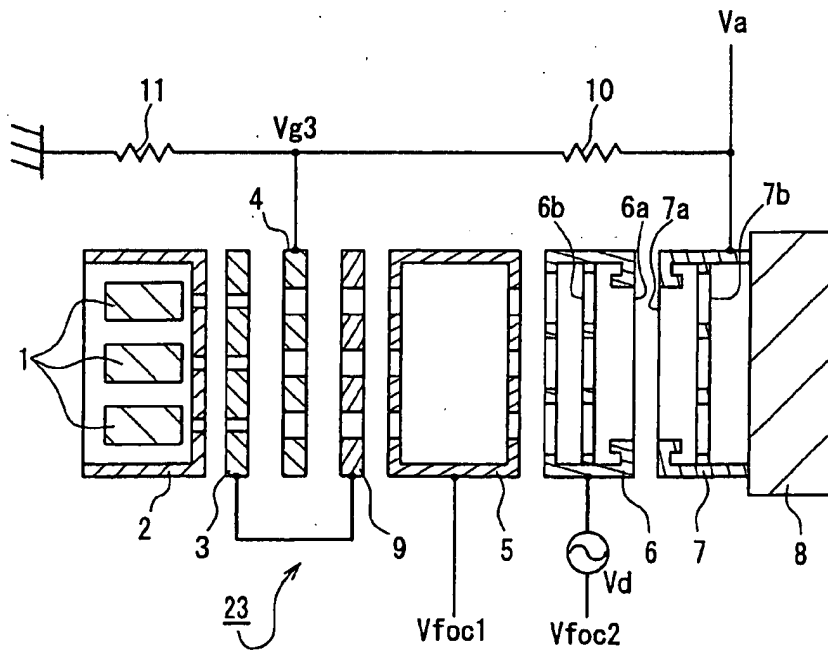


FIG. 2

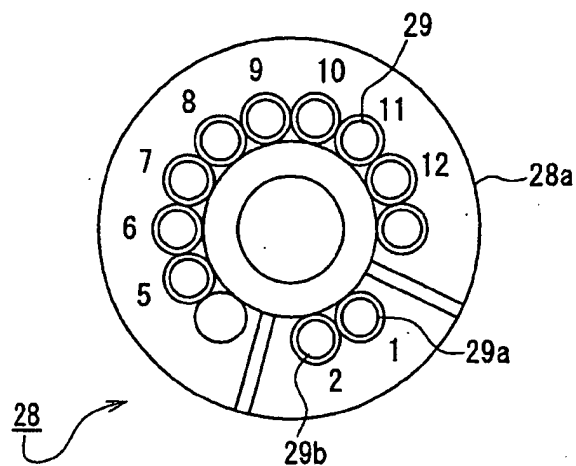


FIG. 3

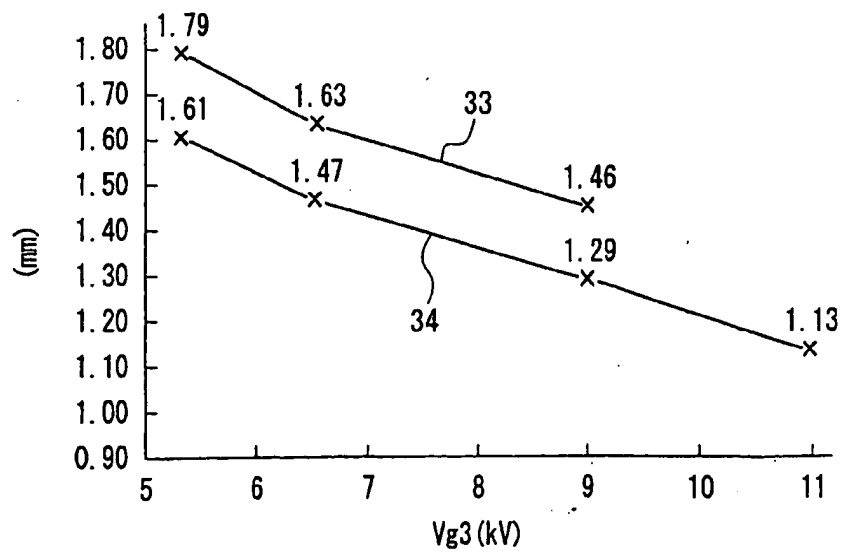


FIG. 4

[illegible]

12/4/2007, EAST Version: 2.1.0.14

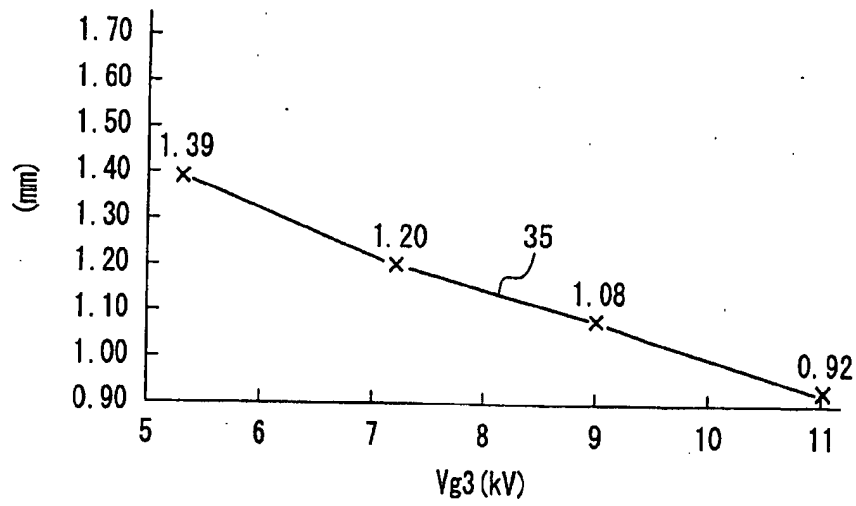


FIG. 7

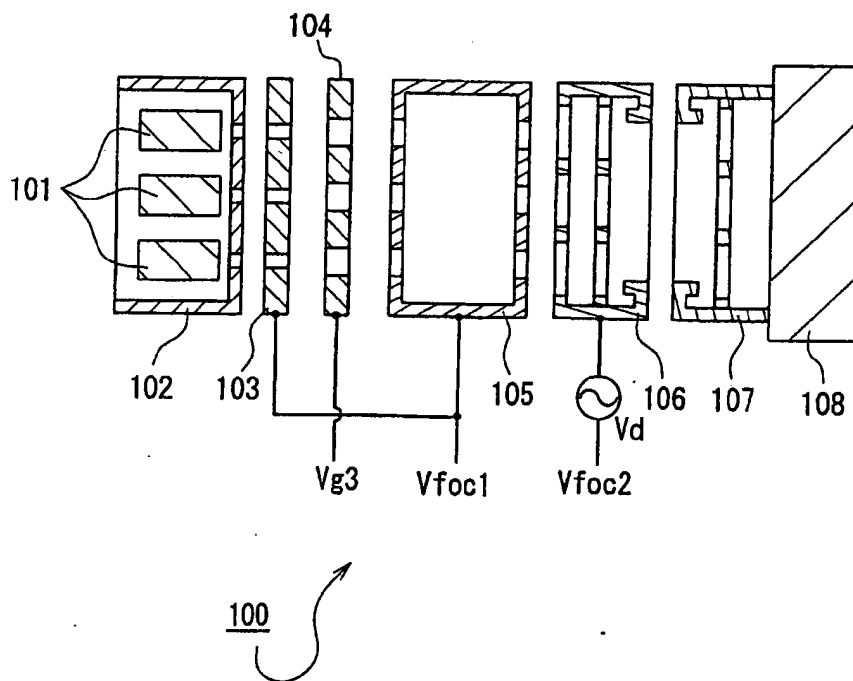


FIG. 8